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Effectiveness of Sodium Hypochlorite in the Prevention of Catheter Related Infections

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Abstract

Vascular access in hemodialysis is a major point of concern in the management of chronic patients. Although arteriovenous fistula remains as the access of first choice, tunneled central venous catheters are still commonly used. Infection remains the principal cause of catheter dysfunction or loss. Many protocols have been used in order to prevent exit site infections and bacteremia. We describe our experience with the use of sodium hypochlorite, an electrolytic chloroxidizer used as a topical disinfectant. It has been shown to be active against a broad spectrum of potential pathogens and has other specific advantages compared to other cleansing agents, including its non-toxic, non-irritating nature and its low cost. We conclude that sodium hypochlorite solution in different concentrations (10 and 50%) is effective in preventing exit site infections and bacteremia associated with tunneled central venous catheters in chronic hemodialysis patients.

Vascular access management represents a major clinical concern in chronic hemodialysis (HD) patients, because its efficiency considerably affects dialysis adequacy and patient morbidity and mortality [1, 2]. While native arteriovenous fistula is considered the access of choice for HD, some specific conditions (acute renal failure, inadequate or exhausted vessels and reduced life expectancy) oblige the use of central venous catheters (CVC) or arteriovenous grafts [3, 4].

Catheter infections are common among chronic HD patients, with an incidence of 18.4/1,000 days among temporary catheters, and 13.6/1,000 days in tunneled cuffed catheters [5]. Catheter infection can occur following transmission of hand or aerosolized bacterial contaminants. *Staphylococcus aureus* is the leading cause of catheter exit site infection (ESI) and bacteremia in HD patients [6, 7]. Bacteremia and tunnel tract infections are the leading causes of catheter loss [8, 9]. The KDOQI guidelines for catheter care include treating the exit site with a skin disinfectant, either chlorhexidine or povidone-iodine, followed by ointment of povidone-iodine or mupirocin [10]. This has been shown to reduce the incidence of ESI. However, certain manufacturers have indicated that the glycol constituents of ointment should not be used on their polyurethane catheters. Mupirocin ointment and certain preparations of povidone ointment contain polyethylene glycol.

Sodium hypochlorite is an electrolytic chloroxidizer, and solutions are used as a topical disinfectant. Chlorine is the active ingredient with a pH of 9.5–10.5. Sodium hypochlorite 50% solution (Amuchina, Italy) contains chlorine (0.55%), and costs less than 10% povidone-iodine or 4% chlorhexidene. It has been shown to be active against a broad spectrum of potential pathogens. In addition, it has some specific advantages compared to other cleansing agents: it cannot be contaminated by bacteria, it is non-toxic and non-irritating, it improves tissue growth, and does not cause sclerosant encapsulating peritonitis [11, 12]. Sodium hypochlorite Y-connector systems have been shown to reduce peritonitis rates by 61% compared to standard systems [13]. Sodium hypochlorite 50% has been effectively used for the prevention of ESI in children treated with chronic peritoneal dialysis (PD) [12]. It was reported to be more effective than 10% povidone-iodine and as effective as 4% chlorhexidine, but with fewer adverse effects, such as local skin irritation. A second group of investigators have also found sodium hypochlorite 50% to be as effective as 10% povidone-iodine for transfer set changes [14]. Furthermore, sodium hypochlorite 3% solution, which costs even less than the 50% preparation, has been found to be as effective in the prevention of ESI in children [12]. Similarly, our own experience with PD patients has demonstrated that with sodium hypochlorite 50% packs in addition to systemic and local antibiotic therapy is effective treatment for ESI, and helped avoid peritoneal catheter removal and need for temporary HD. These packs were left in place for 3 min each day for 2 weeks, after which usual povidone-iodine dressings were resumed.

To our knowledge, there has been no study evaluating the use of sodium hypochlorite for tunneled cuffed CVC in chronic HD patients. In 2004, we used sodium hypochlorite 10% as part of our routine exit site care for tunneled cuffed catheters. Standard catheter care in our center adheres to the KDOQI guidelines. Having noted encouraging results with our PD population, we implemented a policy change in January 2005; thereafter, sodium hypochlorite 50% solution was used.

We compared the incidence of ESI/colonization and catheter-associated bacteremia in the two time periods to assess the efficacy of sodium hypochlorite 50 vs. 10% solution used for routine exit site care in the prevention of these outcomes. Data on these endpoints are routinely prospectively collected as part of center policy. For catheters, blood cultures from both the arterial (red) and venous (blue) ports and exit site swab cultures were performed routinely on a monthly basis, and whenever infection was suspected. Bacteremia was treated with intravenous antibiotics for 4–6 weeks. ESI, as indicated by the presence of erythema, tenderness or purulent discharge, were treated with systemic antibiotics for 2–4 weeks. All systemic antibiotic therapy was based on the culture and sensitivity results. Exit site swab cultures positive for *Staphylococcus epidermidis* without erythema, tenderness or purulent discharge were considered colonization, and no intervention is performed. In the absence of obvious signs of ESI, exit site swab cultures which grew Gram-positive organisms other than *S. epidermidis* were treated locally with Vancomycin packs left in situ over the exit site for 20 min during the HD treatment for 10 consecutive treatments. Exit site swabs which grew *Candida* were always treated with systemic antifungal therapy, based on culture and sensitivity results. No tunnel infections occurred during the observation period.

Data were collected on 37 tunneled CVCs between January and December 2004 (Group A, sodium hypochlorite 10%) and 41 tunneled CVCs in January and December 2005 (Group B, sodium hypochlorite 50%). We compared the incidence-density of ESI/colonization and bacteremia in Groups A and B using chi-square test. A two-sided p-value <0.05 was considered statistically significant.

Results are summarized in table 1. In Group A, 24 catheters had 81 positive exit site swab cultures, or 1 positive site culture per 77 catheter-days. In Group B, 20 catheters had 64 positive exit site swab cultures, or 1 positive site culture per 115 catheter-days. There was a significantly lower incidence of positive exit site cultures with the use of sodium hypochlorite 50%. A significant proportion of these positive exit site cultures were colonization with *S. epidermidis*. The difference between the two preparations of sodium hypochlorite appeared to be largely due to a reduction of exit sites positive for *S. epidermidis*. Considering only ESI involving other organisms, Group A had 1 ESI per 445 catheter-days and Group B had 1 ESI per 435 catheter-days ($p = 0.54$). The cultured microorganisms are listed in table 2. With regards to blood cultures, in Group A, 7 catheters lead to 11 positive blood cultures, or 1 bacteremia episode per 567 catheter-days. Although there were fewer bacteremia episodes in Group B (1 per 1,478 catheter-days), this did not reach statistical significance.

Eighty six percent of the cultures grew Gram-positive organisms, while Gram-negative organisms accounted for 8.7%. The most common organism was

Table 1. Incidence of positive cultures with use of Amuchina 10 and 50%

	Group A	Group B	p-Value
Skin disinfectant	Amuchina 10%	Amuchina 50%	
Total catheter days	6,241	7,389	
Positive exit site cultures	81	64	0.02
Infection	14	17	1.00
Colonization	67	47	0.001
Positive blood cultures	11	5	0.08
Peripheral	2	2	1.00
Arterial port	7	2	0.09
Venous port	2	1	0.59
Total	92	69	0.004

Table 2. Identified microorganisms

	Group A Amuchina 10%		Group B Amuchina 50%	
	Exit site culture	Blood culture	Exit site culture	Blood culture
Gram-positive				
Staphylococcus epidermis	71	4	46	0
Coagulase negative *Staphylococcus* (other than *S. epidermidis*)	2	1	1	0
Staphylococcus aureus	5	2	5	0
Corynebacterium sp.	2	0	1	0
Gram-negative				
Pseudomonas aeruginosa	0	0	2	4
Proteus mirabilis	2	1	0	0
Enterobacter cloacae	0	3	0	0
Enterobacter amnigenus	0	0	1	1
Other				
Candida sp.	4	0	3	0

S. epidermidis, followed by *S. aureus*. Candidal infections accounted for 4.3% of all infections. Our findings are congruent with the literature. *S. aureus* and *S. epidermidis* are reported to be the most common causes of CVC related infections (60%) [15, 16]. Other Gram-positive and Gram-negative account for 25%. Among fungi, an important role is played by *Candida albicans* and *Candida*

In conclusion, catheter-related infections remains of vital concern in the management of chronic HD patients, and prevention of these is an important objective of HD care providers. We conclude that sodium hypochlorite solution is effective in preventing ESI and bacteremia associated with tunneled CVCs in chronic HD patients.

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